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ADDRESS OF THE RETIRING PRESIDENT OF THE SOCIETY, IN AWARDING THE BRUCE MEDAL TO EDWARD C. PICKERING.

By CHARLES S. CUSHING.

At the Twentieth Annual Meeting of our Society it becomes my duty as your retiring President to make a brief statement as to the progress and condition of the Society, and to announce the seventh award of the Bruce Gold Medal.

The total eclipse of the Sun in January, 1889, was the occasion of bringing together in this State many people interested in astronomical science. As a result of that meeting, the Astronomical Society of the Pacific was formed, and those connected with it have every reason to be proud of its progress since the foundation.

California is a land of sunshine and clear skies, and as astronomy appeals largely to the imagination, it is natural that the attention of some of the adventurous spirits who came to our shores during early days was here turned towards the skies. Like conditions bring about like results, and it is as natural for the inhabitants of California to take a continued interest in astronomy as it was for the ancient Chaldean shepherds to begin their observations under climatic conditions so closely resembling our own.

The writer has at times observed among magazine writers and critics a disposition to question whether, in many of the sciences, there has been and is being as much solid work done in the United States as in some of the older and more thickly settled communities of the Old World. All the writers, however, in these discussions except astronomical science from consideration, as it is conceded by all that in the development of this particular science the United States cannot at least be regarded as occupying a secondary place.

In the development of this particular science California has taken a leading part, and I believe it can be said without exaggeration that there is no country in which more has been done, relatively, to establish observatories, to make and carry on useful investigations, and, generally, to cultivate and stimulate the science of astronomy. The contributions to this end, both public and private, have been most remarkable. Donations have been received from those of great and those of slender means to assist in this work.

The establishment of the great Lick Observatory by a pioneer of our State was one of the greatest contributions to modern science. It is probable that no one act has contributed more to the development of astronomical science than this. It has set an example for others to emulate, both within and without the State. It has brought generous contributions, both public and private, to astronomical science. It has brought together a number of scientists, who have contributed largely to scientific knowledge and who are continuing to reflect great credit on the institution so established.

The generosity of one citizen, a member of this Society, has enabled the Lick Observatory to establish and maintain a well-equipped station in the southern hemisphere, from which important results have been attained. The generosity of another, also a member of our Society, has enabled the same observatory to conduct observations of total eclipses of the Sun on many different occasions and necessarily at widely scattered places. These observations have given it opportunities which have probably been unequaled by any other observatory.

It was the existence of the Lick Observatory which brought among us the men whose presence was necessary for the establishment of this Society. The success of this Society has been remarkable, and I have only to point to the numerous applications from observatories throughout the world for its publications to show the esteem in which its efforts are held.

While the interest of the writer in astronomical science is that of an amateur only, whose time is almost wholly engrossed in other vocations, no one knows better than I do the debt which I desire now to publicly acknowledge, which the Society owes to the little band of astronomers of the Lick Observatory. These members of our Society have with the most untiring industry contributed to and assisted in editing its publications over the entire period of its existence. They have lectured for us and have in many ways otherwise contributed to the success of the Society. Above all, they have extended to the members of the Society the privilege of meeting at the Lick Observatory and of seeing the practical workings of that great institution, a privilege the equal of which probably no other like society can enjoy.

Our Society now possesses an endowment of nearly twenty thousand dollars. The income from a considerable portion of this is being devoted towards our *Publications*. At the time of the great fire in San Francisco, of April 18, 1906, the Society had a very considerable library, which it maintained in its rooms in the building of the California Academy of Sciences. While in the destruction of this library the Society suffered severely, the generosity of various members and societies has done much to repair this loss.

I take pleasure in announcing that the library of the Society now consists of about two hundred and eighty-five bound volumes and about seven hundred pamphlets. Among the many contributions to the rehabilitation of our library I desire to refer particularly to that of Professor W. STEADMAN ALDIS, F. R. A. S., of Oxford, England, who contributed fifty volumes, many of which are rare, and all of which are valuable; and to that of Professor EDWARD S. HOLDEN, who has sent a valuable contribution of books and pamphlets. Nearly all of the large observatories, including the observatory at Greenwich, United States Naval Observatory at Washington, and the Lick Observatory, have sent either complete sets of their own publications or sets as nearly complete as they could spare. In specially mentioning the foregoing contributions I have not forgotten the many other generous gifts to our Society. By the courtesy of the President of the University of California these books are housed at the Students' Observatory at that institution. The rapid rebuilding of San Francisco brings to mind the desirability of obtaining for the Society permanent rooms in San Francisco, where the library can be maintained and made accessible to those desiring to use it.

Among the funds of our Society is one contributed by the late CATHERINE WOLFE BRUCE, of New York, to be used for the purchase of a gold medal to be awarded, regardless of race or sex, for distinguished services to astronomy. By the terms of the trust creating this fund the medalist is chosen by the Board of Directors of the Society from persons nominated by six of the most prominent observatories of the world—viz.: Berlin, Harvard, Greenwich, Lick, Paris, and Yerkes.

This medal has been awarded in the past successively to Professor SIMON NEWCOMB, Professor ARTHUR AUWERS, Sir DAVID GILL, Professor GIOVANNI VIRGINIO SCHIAPARELLI, Sir WILLIAM HUGGINS, and Professor HERMANN CARL VOGEL. It now becomes my pleasure to announce the seventh award of this medal to Professor EDWARD C. PICKERING, Director of the Harvard College Observatory.

While the name of Professor PICKERING and his connection with Harvard College is so well known to all who take any interest in astronomy, it will not be out of place to here refer briefly to his career and to some of his many achievements.

EDWARD C. PICKERING was born in Boston, July 19, 1846. He graduated at Harvard College in 1865, and acted as a teacher of physics at the Massachusetts Institute of Technology for a period of ten years. Professor PICKERING'S advent into astronomy came in the year 1877, when he became Director of the Harvard College Observatory. Prior to that time he had been more of a physicist and mathematician than an astronomer. At about the time Professor PICKERING became Director of Harvard Observatory, the rapid development of stellar photography and of stellar spectrum analysis emphasized the importance of the department of astrophysics. It is much to the credit of those who selected our medalist for the important position, which he has so long occupied, that they so early recognized the fact that the new director must be a chemist and a physicist.

During the nineteenth century scientific development along almost every line has been very rapid, and in no science is this more marked than in astronomy. The great development of photography and spectroscopy brought greater demands on the intelligence of the astronomer along lines which during the early part of the nineteenth century were hardly dreamed of. Professor PICKERING did not hesitate to start in immediately after his advent into his new position to undertake works of vast magnitude, and in carrying his plans into effect he has shown the most unbounded energy, as well as unusual executive ability.

In his first annual report he announced his intention of undertaking the extensive work of reducing Argelander's comparative observations of variable stars, by measuring the brightness of the comparison stars, and thus determining the true brightness of the variables as given in the "Bonn Observations." This work he published some years later. The first paper on the subject was published in 1880, wherein, from mathematical reasoning, he proves that the variability of stars of the *Algol* type is due to a non-luminous body revolving around the star; the results he obtained from the ratio of the diameters of *Algol* and its satellite are very closely accordant with those announced by VOGEL some years later.

Professor PICKERING's name will always be associated with the work carried on under the name of the Henry Draper Memorial. Professor HENRY DRAPER was a distinguished scientist, who was especially noted for his labors in celestial photography. In the year 1886 his widow made a liberal provision for carrying on researches in stellar spectroscopy as a memorial to her late husband. It is natural that the work proposed by her was along lines of investigation in fields which her husband had hoped to explore.

The trust was placed in the hands of Professor PICKERING, who was thus enabled to work with sufficient means to carry the task into execution. The investigations were planned to cover the entire sky, and involved an investigation into the conditions and physical properties of the stars as revealed by their spectra; and as the scheme was developed four telescopes were established for the observations, two at Cambridge and two at Arequipa, Peru. This work has been prosecuted to the present time with amazing industry.

Under the direction of Professor PICKERING, since its establishment, the Henry Draper Memorial has developed several new and unique lines of work. The objective prism and doublet have been substituted for the slit spectroscope and single lens, and by this means the spectra of a large number of stars are photographed simultaneously instead of singly by the former method. These photographs have been repeated until every portion of the sky has been covered. By this method a photograph of the spectrum of every star in the sky permanently brighter than the ninth or tenth magnitude, besides many thousand that are fainter, has been obtained. These plates have been carefully examined, and as a result a large number of objects having peculiar spectra have been discovered.

To illustrate one of the results of this work it may be interesting to state that of eight novæ which are known to have appeared during the sixteen years prior to 1902 two were visible to the naked eye. All the others were found from the Draper photographs, and but for these photographs would probably never have been discovered.

The minor planet *Eros* was discovered in 1898 by WITT, but the examination of the Harvard photographs enabled Professor PICKERING to announce that it could be detected on fifteen or sixteen plates taken from 1893 to 1896, and that the spectrum photographed in January, 1894, was, like that of other planets, and the Sun, of the second type. A photograph taken in 1894 shows the planet as a long trail, while the images of the stars are round.

The vast work carried on at the two observatories under the name of the Draper Memorial included repeatedly photographing all portions of the sky, both Northern and Southern. By this means a map of the sky, showing all the brighter stars night after night, was made. The records of these observations furnish a complete history of the heavens every year since 1890. It is obvious from this that when any new object is discovered its history can be traced through these photographs. No such collection of photographs has ever been made, and the collection is as unique as it is vast.

The number of these photographs exceeds fifty thousand, and when we consider that these figures represent repeated surveys of the entire heavens—spectrographic, photometric, and photographic—and that these extend over a large number of years, one cannot but be impressed by the vast amount of work done in this undertaking, and with the energy and ability with which it was carried into effect.

In the year 1889, Miss CATHERINE BRUCE, of New York, placed at the disposal of Harvard University a large sum of money to purchase a 24-inch photographic telescope. When this telescope was completed it was mounted at the Arequipa

Observatory, where it has since been regularly used. This was a most welcome and material acquisition to the observatory, and an immense number of photographs have been taken with it.

The generous donor of this telescope was the same lady whose high appreciation of astronomical efforts caused her to present to the Astronomical Society of the Pacific the fund known as the Bruce Medal Fund, to which I have already referred. The medal now presented to Professor PICKERING is awarded from that fund in accordance with the directions from Miss BRUCE.

It is interesting to know that the generosity of Miss BRUCE in presenting the telescope above referred to undoubtedly assisted our medalist in his untiring efforts, and its use must be regarded as a factor in enabling him to win the medal now presented to him. Thus, Miss BRUCE has assisted astronomical science in two different directions, and on both sides of our continent.

Greatness in a commanding general consists not alone in individual effort and accomplishment, but in the ability to utilize the efforts of others. Professor PICKERING'S accomplishments are along both of these lines. During his directorship of Harvard Observatory it has risen from a comparatively small institution to its present position as one of the leading observatories of the world. He has organized its work and directed it in fields of great usefulness, and in such a manner as not to conflict with, or overlap upon, the work of other observatories.

Through his foresight, a finely equipped observatory has been established in Peru under most advantageous climatic conditions, thus making Harvard Observatory, in this respect, the best equipped of all observatories.

In dwelling particularly on the genius of our medalist for organization, and for utilizing the efforts of others, the writer does not desire to detract in any manner from his many purely personal triumphs as an astronomer. His thorough grasp of the many sides of astronomical work cannot be better illustrated than by referring to his ability to create important instruments for astronomical work. Among these is his meridian photometer, an instrument for measuring and comparing the brightness of stars. While this instrument must be regarded, to some extent, as an adaptation of previously existing instruments, Professor PICKERING has introduced so many important modifications as to make it in reality an original instrument.

Our Society has every reason to feel greatly proud of the manner in which this medal has been previously awarded. The list of awards is a roll of honor on which any scientist would be pleased to find his name inscribed, yet the writer knows that there is a feeling among members of our Society that the award to Professor PICKERING has been too long delayed.

In closing it may not be out of place to state a few of the many reasons why this medal is awarded to Professor PICKERING. As Director of Harvard College Observatory, he has given evidence of rare executive ability, of a remarkably clear and comprehensive insight into the great problems of sidereal astronomy, and of great resourcefulness in devising the most promising methods of attacking them, and in designing new instruments to carry out these attacks.

This unusual combination of gifts has enabled him to organize effective work on a large scale in at least three distinct though related fields—stellar photometry, stellar photography, and the study of stellar spectra. Thus, the Harvard College Observatory stands unique among the astronomical institutions of the world in possessing a vast library, to use Professor PICKERING'S own happy comparison, of photographs of incomparable value, containing a complete history of the aspect of the entire heavens for nearly twenty years, and a complete record of the spectra of at least all stars as bright as the eighth magnitude.

In its record for the discovery of new and variable stars the observatory also stands without a rival, and only the Potsdam Observatory approaches it in the field of determining the photometric magnitudes of the stars.

To develop such an institution, and to successfully direct the execution of such extensive and important researches would seem to give sufficient exercise for the energies of the ablest man; but Professor PICKERING is also an enthusiastic and tireless observer, and his personal researches, especially in the study of variable stars and in the photometric measures of stars, particularly with his ingeniously devised meridian photometer, constitute contributions to the advancement of astronomy of which any investigator might well be proud, and which in themselves would afford ample ground for the award of this medal.

The foregoing brief narrative will, I trust, to some extent show the wisdom of our Board of Directors in awarding this medal to Professor PICKERING. Our medalist is still relatively a young man, and while his achievements have been vast, they are by no means ended, and we have every reason to believe that what has been done is but earnest of what will be done by him.

In the absence of Professor PICKERING, I request you, Mr. Secretary, to transmit this medal to the distinguished scientist to whom it is awarded, with the congratulations and best wishes of the members of this Society, that he may long live to enjoy his honors so fairly won.

THE CROCKER ECLIPSE EXPEDITION OF 1908 FROM THE LICK OBSERVATORY, UNIVERSITY OF CALIFORNIA.

By W. W. CAMPBELL.

The Moon's shadow for the total solar eclipse of January 3, 1908, fell upon the Earth at sunrise in longitude 155° east and latitude 11° north, swept easterly across the central Pacific Ocean, and left the Earth at sunset on the western coast-line of Costa Rica. The shadow path crossed only two known landmarks—Hull Island, about seven hundred miles north of Samoa, and Flint Island (British), in latitude 11° south, four hundred and fifty miles northwest of the Island of Tahiti. The eclipse lasted sixty per cent longer and the Sun was much nearer the zenith at Flint Island than at Hull Island; and both were equally difficult of access.

On account of our position, on the Californian coast of the Pacific, and in view of our considerable experience in eclipse observation, there existed amongst astronomers a feeling that the Lick Observatory should, if possible, take care of this